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An Assessment of Sedentary Time Among Undergraduate Students at an Urban Canadian University

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Graduate Program in Health and Rehabilitation Sciences
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Abstract

The purpose of this study was to calculate a total daily sedentary time for the undergraduate population at a large urban Canadian University and discover student perceptions on the facilitators and barriers to engaging in a less sedentary lifestyle. A sample of 335 participants responded to an online survey, with 102 participants included in the quantitative analysis and 145 included in the qualitative analysis. Participants responded to the SIT-Q Sedentary Behaviour Questionnaire and two opened ended questions. Analysis of the SIT-Q demonstrated that undergraduate student's have daily sedentary times similar to previously studied adults with a significant amount of sedentary time allocated to study. Three themes were identified as facilitators to engaging in a less sedentary lifestyle: 1) access to a gym, 2) student jobs, and 3) walking to and on campus. Two themes were identified as barriers to engaging in a less sedentary lifestyle: 1) sitting in class and 2) studying outside of class. The results suggest that like desk-based working adults, undergraduate student's have levels of sedentary behaviour that warrant further investigation and intervention, perhaps most effectively within the university classroom.

Keywords: Sedentary Behaviour, Sedentary Time, University Students

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Chapter 1: Introduction

In 1976, a Californian cartoonist by the name of Robert Armstrong developed a series of comics that popularized the term “couch potato” and he would go on to trademark the term with the United States government (Moss, 2015). Armstrong later developed comedic books titled “The Official Couch Potato Handbook” and “Couch Potato Guide to Life” that depicted these characters in highly sedentary states that often included watching television (Moss, 2015). What it means to be sedentary has change since the 1970s and new evidence suggests that there is a significant distinction between sitting on the couch for too long and exercising too little (Owen, 2012). The Canadian Physical Activity Guidelines (CPAG) state that adults between the ages of 18-64 should take part in 150 minutes of moderate to vigorous physical activity (MVPA) per week in order to receive health benefits (Tremblay et al., 2011). However, researchers have found that an individual can follow these guidelines and still exhibit dangerous levels of sedentary behaviour, putting them at risk for various chronic conditions (Fox, 2012). The health risks associated with sedentary behaviour exist across the entire life span from school-aged children (Tremblay et al., 2011), working aged adults (Phillips, Thomson, Dunstan, Thorpe & Healy, 2010), and the 60+ population (Gardiner, Eakin, Healy & Owen, 2011). However, significantly less attention has focused on the sedentary behaviour of university-aged students (Buckworth and Nigg, 2004), leaving an important gap in the research. On average, desk-based workers sit for 6 hours out of an 8-hour work day (Alkhajah et al., 2012), and are therefore heavily targeted for intervention. In many ways, university undergraduates work similar to white collar, desk-based jobs (e.g., seated at a desk in lectures, library and at home for hours at a time) for their time on a university campus and therefore should be targeted for intervention in the same ways as desk-based workers. When undergraduate students have completed their

recommended level of physical activity for the week, there are a remaining 9910 minutes in which they could potentially participate in sedentary behaviours. At a ratio of 66:1 in favour of sedentary time, highly active individuals can engage in levels of sedentary behaviour that can put them at risk for obesity, breast cancer, colon cancer, heart disease, diabetes, hypertension and overall risk of hospitalization (Varo et al., 2003). Pate et al. (2008) define sedentary behaviour as any energy expenditure of 1.0 to 1.5 metabolic equivalent units (METs), when “one MET is the energy cost of resting quietly” (Pate et al, 2008, p. 174). Wilmot (2014) stated that sedentary behaviour is any waking behaviour that occurs in the position of sitting or lying down. This includes pleasurable activities such as watching television or computer use (Wilmot, 2014) but also goal-oriented behaviours included in office-based settings and university students attending lectures and studying, assuming that they are in a seated position. The health risks posed by this new concept of sedentary behaviour is particularly troublesome in a technologically advancing society where more and more careers are spent at a desk and new innovations that make life *easier* may actually be pushing people closer and closer to disability (Owen et al., 2010).

The following literature review includes a discussion of previous studies of sedentary behaviour, the presentation of the current definition of sedentary behaviour and the controversies that exist within it, followed by the associated health risks of living a highly sedentary life and the new paradigm of inactive physiology. Finally, the rationale behind focusing on undergraduate students and previous sedentary behaviour research targeted towards undergrads will be provided.

Chapter 2: Literature Review

Defining Sedentary Behaviour

In 2008, Pate et al. defined sedentary behaviour as energy expenditure from 1.0 to 1.5 metabolic equivalent units (METs). The researchers note that household activities such as washing dishes and cooking can raise energy expenditure above 1.5 METS and therefore should not be considered sedentary behaviour. Pate et al. (2008) furthered this notion when they collected accelerometer data from two separate women who engaged in very different activities on the same day. The first woman, who would be labeled as inactive based on the CPAG, participated in light physical activity (housework) for 75% of her day and was sedentary for the remaining 25% of the day. The second woman, who participated in traditional exercise and would be classified as active based on the CPAG engaged in one hour of moderate to vigorous physical activity but spent the overall majority of her day in a sedentary state. Once the monitoring period was over, their accelerometer data was collected and showed that the first woman had performed an estimated 2.7 MET hours more of activity despite not participating in the recommended 150 minutes a week of MVPA. Pate et al. (2008) concluded that energy expenditure must be considered in a definition of sedentary behaviour. This definition has been cited frequently among other researchers (Owen et al, 2010; Bauman et al, 2011) however, various researchers have rejected this definition and some controversy on a proper definition still exists (Fox, 2012; Tremblay, 2010). Fox (2012) claimed that a definition that relies solely on energy expenditure is too inclusive and leads people to believe that the difference between “too little exercise” and “too much sitting” is a problem of semantics and not science. Fox (2012) used a process of elimination when defining sedentary behaviour. Sedentary behaviour is not merely the lack of dedicated exercise, it is not avoided by meeting exercise guidelines, and it is not a certain level of energy expenditure. However, Fox (2012) does not put forth his own

concrete definition. Tremblay (2010) adds to this notion by stating that researchers either define sedentary behaviour as not taking part in physical activity or by energy expenditure. However because evidence suggests that the two parameters do not impact health in the same way, the two definition options are not necessarily compatible. In addition, Varo et al. (2002) noted that some authors have attempted to study the prevalence of sedentary lifestyles by studying the number of hour's people spend sitting down in a regular day or based on other physical activities. They discuss the problem of these kinds of activities being too general and not being able to relay specific information. It follows that a specific measurement needs to be applied to the ambiguous term of sedentary behavior.

Recently, a definition combining the parameters of energy expenditure and posture has been created. Gibbs et al. (2014) define sedentary behaviour as low intensity movement (less than 1.5 METs) and a posture that involves sitting or reclining and this same definition has been cited by the Sedentary Behaviour Research Network (2015). Recent interventions may explain the rationale for the addition of posture in the definition. Carr, Walaska, and Marcus (2012) provided 18 full time employees in sedentary occupations with pedal machines while at work for 4 weeks. The use of the device was recorded and feasibility was measured and demonstrated that it is possible to reduce sedentary behaviour in a workplace setting while employees remain seated. A similar intervention was completed by Maeda et al. (2014) when they studied the feasibility of retrofitting a university library with portal pedal machines. The average pedal time per day was 95.5 minutes, again demonstrating the reduction in sedentary behaviour while remaining seated, conflicting with definitions from the past. The evolution of the definition of sedentary helps to advance knowledge and opens the door for more complex interventions, but a serious problem persists for those who wish to get an accurate estimation of how prevalent dangerous levels of sedentary behaviours are in society. Reducing the definition to energy

expenditure and posture simplifies the term but provides researchers with a means of gathering information on what activities constitute sedentary behaviour and how long an individual might be participating in these activities each day. The current definition does nothing to advance knowledge on just how long an individual should be active each day in order to avoid negative health effects. If researchers were to use the definition of 1.0 to 1.5 METs for each sedentary behaviour to determine prevalence, it would be safe to assume that they would find that 100% of society is sedentary as everyone sits or lies down at one point or another. Based on the work put into the CPAG, it is now known that physical inactivity can be defined as less than 150 minutes of moderate to vigorous physical activity per week, and puts individuals at risk for negative health consequences (Tremblay et al., 2011). A similar definition of sedentary behaviour needs to be created in order to fully understand the magnitude of the sedentary behaviour problem in society. People participate in sedentary behaviours such as sitting every day, but when these activities accumulate into a lifestyle, they need to be further explored and defined. Varo et al. (2003) put forth a definition for sedentary lifestyle that stated: they “expended less than 10% of their leisure-time energy expenditure in activities that required greater than 4 METs” (Varo et al., 2003, p. 139). However, this definition is supported by a single study and at a time when sedentary behaviour research was in its infancy. At this point in time, it is unknown how long or what percentage of a day an individual should be active to avoid negative health consequences. Once all subgroups of the population have been studied, which includes undergraduate students, proper guidelines can be pieced together and true prevalence information can be determined.

Measurement Issues Associated with the 1.5 MET Definition of Sedentary Behaviour

In a study completed by Mansoubi et al. (2015), the researchers collected accelerometer data on 51 adults who were divided into two categories: healthy weight and obese. The accelerometer data was collected during multiple tasks including watching television, typing,

using a PlayStation Portable (PSP), playing with a Wii gaming system and standing still. The PSP is a handheld video game that involves using the thumbs to press multiple buttons and the Wii is a more interactive gaming system that can involve swinging of the arms and running on the spot. The average standardized MET values for the healthy group were 1.46 METs for TV, 1.62 METs for typing, 1.58 METs for the PSP, 2.29 METs for the Wii, and 1.74 METs for standing still. The average standardized MET values for the obese group was 1.17 METs for TV, 1.23 METs for typing, 1.21 METs for the PSP, 1.80 METs for the Wii, and 1.41 METs for standing still. The healthy group had significantly lower levels of energy expenditure for all behaviours studied. The results of this study demonstrate that there is a problem with the currently accepted definition of sedentary behaviour. Mansoubi et al. (2015) demonstrated that it is possible for certain individuals to be standing and still being sedentary based on the definition of 1.0 to 1.5 METs. Some sitting behaviours that are commonly associated with sedentary behaviour such as typing are actually non-sedentary for at least a proportion of the population. This study provides a rationale for a modification to the remaining ambiguous term of sedentary behaviour.

Previous Studies Demonstrating Distinction Between MVPA and Sedentary Behaviour

Various researchers have aimed to demonstrate this above-noted new concept of sedentary behaviour. Whitfield, Gabriel and Kohl (2014) had marathon and half marathon runners complete the Multicontext Sitting Time Questionnaire and report their peak training duration. The median training time was 6.5 hours per week, the average time sitting in a workday was 10.75 hours, and average sitting time in a non-work day was 8 hours (Whitfield, Gabriel and Kohl, 2014). The researchers demonstrated that the most fit and active individuals who exercise at levels above the CPAG can still be highly sedentary. They may engage in compensatory

behaviours in which after performing dedicated exercise they may feel that they have earned the right to sit or lay down for the rest of the day because they have completed their workout. In a more biologically focused study completed by Gando et al. (2014), the researchers had 807 adults, separated into two groups of <50 years and >50 years old, participate in physical activity and the duration and intensity was measured by triaxial accelerometry. The purpose of the study was to conclude whether light intensity exercise could have the same effect on insulin resistance as MVPA. Each participant wore the accelerometer for 28 days and the researchers only included days that the participants wore the device from upon waking in the morning until they went to sleep at night. Blood samples were taken to measure the level of insulin resistance and glucose. The results demonstrated that light physical activity is inversely associated with insulin resistance in elderly women independent of how often they participated in MVPA. The findings suggest that replacing inactivity with light physical activity can help fight insulin resistance. The authors concluded that this gives older women a viable option for health benefits if they have barriers to participating in MVPA (Gando et al., 2014). In addition, Kulinski et al. (2014) fitted 2223 participants with accelerometers and measured their exercise levels, sedentary time, and cardiorespiratory fitness. Exercise was measured in mean minutes per day, sedentary time was measured by less than 100 counts per minute and cardiorespiratory fitness was measured using a submaximal exercise treadmill test. After the participant had worn the accelerometer for 7 consecutive days, the activity patterns of the participants were collected. The researchers used multivariable adjusted linear regression analysis with fitness as the dependent variable. Kulinski et al. (2014) were able to conclude that 6 to 7 hours of sitting time counteracted the beneficial effects of an hour of exercise.

Health Risks of Sedentary Behaviour

The following chronic conditions have been linked to sedentary behaviour among various populations:

Metabolic Syndrome and Sedentary Behaviour. Chew, Gan, and Watts (2006) define metabolic syndrome as a cluster of cardio-metabolic risk factors that includes abdominal obesity, high blood pressure, and hyperglycemia, and put individuals at a higher risk of developing other chronic conditions such as cardiovascular disease and diabetes. Researchers concluded that if people limited their television viewing and computer time to less than 1 hour a day, metabolic syndrome in the United States could be reduced by 30 to 35% (Ford et al., 2005). With today's reliance on computers for both pleasure and work, and the common pass time of watching television, such a figure would be difficult to obtain. Ford et al. (2005) found that the incidence of metabolic syndrome was higher in individuals who spent more time in a sedentary state. In a study completed by Carson and colleagues (2014), 4,935 Canadian adults aged between 20 and 79 years old filled out questionnaires in their own homes and were followed up by a visit to a mobile examination center to record various cardiometabolic biomarkers including waist circumference, systolic and diastolic blood pressure, high density lipoprotein (HDL), cholesterol, and C-reactive protein. After the visit to the mobile examination center, the participants were fitted with an accelerometer and told to wear the device on their right hip for waking hours for 7 consecutive days. Total sedentary time, time spent in bouts of sedentary behaviour greater than 20 minutes, number of sedentary breaks, and minutes of MVPA were measured and recorded. Independent of MVPA, the researchers found significant linear associations between total sedentary time and time in bouts of greater than 20 minutes of sedentary time with insulin and diastolic blood pressure. In addition, reduced total sedentary time and sedentary breaks had

beneficial associations with waist circumference, systolic blood pressure, HDL cholesterol, triglycerides, glucose and insulin.

Cardiovascular Disease and All-Cause Mortality. In an American study of 240, 819 participants, researchers aimed to measure television viewing and overall sitting time (Matthews et al., 2012). After controlling for the confounding factors of age, race, sex, MVPA, education and diet, they found that television viewing was associated with all-cause cardiovascular and cancer mortality due to its sedentary nature. Regardless of whether or not the participants received the recommended level of MVPA each day, the link between television viewing and all cause cardiovascular and cancer mortality remained (Matthews et al., 2012). In addition, the researchers were able to establish a dose-response gradient between television viewing and all-cause mortality. Katzmarzyk and Lee (2012) determined that the estimated life gains in the United States would be 2 years if the population reduced overall sitting to less than 3 hours a day and 1.38 years if the population reduced television viewing time to less than 3 hours a day. Katzmarzyk and Lee (2012) concluded that sitting and overall sedentary behaviour literally takes years off of the average American's life.

Obesity. Abdominal obesity has been correlated to various cardiovascular conditions such as cardiovascular disease, coronary death, coronary heart disease, heart failure and stroke (Perez et al., 2007). Hu et al. (2003) studied 50,000 women from 11 states who had a BMI of less than 30 and were asked to complete a questionnaire that revealed details of their sedentary behaviour and physical activity levels for baseline measures. At follow up 6 years later, 7.5% of the women who were not obese at baseline displayed a BMI greater than 30, categorizing them as obese. This increase of BMI was associated with the amount of television the women had watched. The researchers also found that sitting at home or at work was associated with an increased risk of becoming obese and time spent standing or walking while at home was

associated with keeping a lower BMI (Hu et al., 2003). Further attention must be paid to those activities that are not categorized as MVPA but can make a significant difference in daily sedentary behaviour. Reiff, Marlatt and Dengel (2012) contributed to the evidence associating the high level of sitting in schools and obesity of school children. Twenty young (average age of 22.8) healthy adults were recruited and asked to answer simple mathematical questions while using a standing desk or a traditional sitting desk. The results showed that the use of a standing desk increased caloric expenditure significantly when compared to a sitting desk. Based on this study with adults, researchers estimate that when a child uses a standing desk they could expend approximately 114 kcal/day per year which translates into approximately 5.85 pounds lost each year (Reiff, Marlatt & Dengel, 2012). In addition, Hu et al. (2003) stated that 30% of obesity could be prevented by following a lifestyle that involved less than 10 hours a week of watching television and more than 30 minutes a day of brisk walking.

Telomere Length. Telomeres are specialized structures at the end of chromosomes that keep the structure stable (Blackburn, 1991). Telomeres allow the DNA to replicate and ensure overall survival of the cells. Longer telomere length has been linked to longevity (Sjogren et al., 2014). Research has shown an association between a low BMI, healthy diet and physical activity, and longer telomeres (Mirabello et al., 2009). In a 6 month randomized controlled trial completed by Sjogren et al. (2014), 68 year old sedentary and overweight males and females who reduced sitting time showed significant lengthening of telomeres in blood cells. The authors also report that an increase in exercise was linked to telomere shortening and they found no relationship between steps taken per day and telomere length. This data suggests that when the proper balance is found, exercise and activities that reduce sedentary behaviour can work together to increase the length of telomeres and improve overall health.

Inactive Physiology: the physiological mechanisms of sedentary behaviour. The potential benefits of exercise have been documented for many years. There is a large body of evidence showing the dramatic healthy effects of exercise on the body. Fentum (1994) states that regular exercise enhances metabolic capacity and nutrient blood supply and increases the strength and contractibility of skeletal muscles as well as various improvements in joints including lubrication, range of movement and the maintenance of flexibility. In addition, cardiovascular benefits of exercise include regulation of arterial blood pressure, improvement of the electrical stability of the heart, and decreased the probability of cardiac arrhythmias (Fentum, 1994). More recently, O'Donovan et al. (2013) attempted to find a relationship between objectively measured habitual exercise and arterial stiffness in individuals who had recently been diagnosed with hypertension. They found that habitual exercise of all kinds, which would include light intensity exercise, is related to decreased arterial stiffness. The benefits of exercise seem all too obvious today. However, inactive physiology has received less attention and only recently has become a topic of interest. Hamilton et al. (2004) note that less is known about the physiological responses and cellular signals attributed to sedentary behaviour. Bey and Hamilton (2004) examined the regulation of lipoprotein lipase (LPL) in skeletal muscle during physical inactivity in comparison to low intensity contractile activity of ambulatory controls. LPL is an enzyme that binds to lipoproteins in arteries and veins and is required for the hydrolysis of triglycerides that are encapsulated in lipoproteins. (Hamilton, Hamilton & Zderic, 2007). A loss of LPL activity may be linked to obesity, type II diabetes and coronary heart disease because it causes optimal tissue specific uptake of the lipoprotein-derived fatty acids (Hamilton, Hamilton & Zderic, 2004). When preventing the ambulatory activity of one or more hind limbs of rats it was found that a rapid loss of LPL activity occurred. LPL activity decreased in the three different hind limb muscles that were controlled for movement and LPL activity was reversed when rats participated

in slow treadmill walking. The LPL loss was shown in both sexes of rats and also in mice, and two different methods of inactivity were used and similar results were found (Bey & Hamilton, 2003). In comparison, short term exercise (run training) was found to increase skeletal muscle LPL by 2 to 2.5 times in the least oxidative areas of the leg muscle and this increase was compared to non-exercising control rats with spontaneous standing and light ambulatory activity (Hamilton et al., 1998).

The Importance of Undergraduates in Sedentary Behaviour Research

The vast majority of sedentary behaviour research has focused on school-aged children (Rey-Lopez, Vicente-Rodriguez, Biosca, and Moreno, 2008) and working adults (Phillips et al., 2010), while others note that significantly less attention has been paid to the sedentary behaviour of students (Buckworth and Nigg, 2004). Alkhajah et al. (2012) report that desk based employees spend 6 hours out of an 8 hour work day sitting. Based on this information, in a 40 hour work week, the average desk based employee will accumulate 30 hours of sitting time while at work. This can be compared with the work completed by Miller and Brown (2004) who found that working individuals spend 9.4 hours a day sitting with 52% of the total sitting time taking place while at work. Furthermore, those classified as having “white collar”, professional jobs were recorded as having the highest amount of sedentary time. A white-collar employee can be defined as “belonging or pertaining to the ranks of an office and professional workers whose jobs generally do not involve manual labor or the wearing of a uniform or work clothes” (Dictionary.com). In many ways, university undergraduates work in lecture halls and libraries in a similar sedentary setting as these white-collar employees in offices with the main difference being level of pay. Macneela and colleagues (2012) estimated that undergraduate students spend 17.3 hours in classes and tutorials and another 10.6 hours allocated to personal study time either

at home or on campus. This can be compared to information provided by Western University to its first year engineering undergrad students. The faculty states that a first year engineering undergrad can expect to have 32 hours of class each week, divided into lecture, tutorials and laboratory hours, and this does not include personal study time (Western University, 2015).

Researchers may show that there is a broad range of sedentary behaviour levels among different faculties on a university campus. It is hypothesized that undergrads have levels of sedentary behaviour that mimic or even surpass white-collar workers because like the majority of office based settings, when a student is in lecture, tutorial or privately studying at home or in a library, sitting is their only option. These numbers are significant considering life expectancy from birth in the United States could be increased by 2 years if sitting time could be reduced to less than 3 hours a day (Katzmarzyk and Lee, 2013). It is important to understand the daily activity patterns of young people as they enter a formative stage and develop the foundation of adult life patterns (Irwin, 2004). According to the Association of Universities and Colleges of Canada (2011), the number of undergrads enrolled in full time programs surpassed one million meaning that there is a huge potential for change. Students who attend university are the leaders and decision makers of tomorrow and may establish social and cultural norms for the entire Canadian population (Leslie, 1999). These students develop future careers including teachers, doctors and managers who influence the health behaviours of the rest of the population (Rouse and Biddle, 2010). It is therefore important to understand and quantify the sedentary behaviour of university undergraduates in order to understand the extent to which sedentary behaviour is of concern for this population, and to eventually establish functional interventions to decrease this behaviour while they are at school and in the later domains of life. The best predictor of behaviour is past behaviour (Verplanken and Van Knippenberg, 1998) and if sedentary behaviour can be reduced

and sustained during the university age, these students can develop strategies to remain active and healthy for life.

Previous Sedentary Research on Undergraduate Students

As mentioned earlier, the vast majority of sedentary behaviour research has focused on populations other than undergraduate students although a paucity of research in the area does exist (Buckworth and Nigg, 2004). Buckworth and Nigg (2004) recruited students in classes at a large Midwestern university in the United States. The study sample included 215 students from the autumn semester and 278 from the spring semester and spanned a variety of ethnic backgrounds including Caucasian (73.8%), African American (16.2%), Asian (3.8%), Hispanic (2.2%), and other ethnic groups (4%). The mean age of the participants was 21 years old with 90.8% of the participants being in the 18-24 age range. The classes that were included in the study were elective conditioning activity courses that consisted of a 50-minute lecture and 45-minute exercise labs 3 times a week. The researchers aimed to obtain information on exercise behaviour, physical activity history and sedentary behaviour by administering a questionnaire during the first class of the 10-week academic quarter. The results of the questionnaire showed that students self-reported total sedentary behaviour time in one week as 29.72 hours divided into TV/videos (10.56 hours), study (13.25 hours), and computer use (5.96 hours). Men reported an overall higher level of sedentary behaviour than women with higher amounts of time spent watching TV, videos, and using the computer, and less time spent in study. While Buckworth and Nigg (2004) make an important contribution to the research, a number of limitations can be recognized in the work. First, the study sample included students who were enrolled in elective courses involving conditioning activity. This population is vastly different from the average undergraduate student who is not actively enrolling themselves in classes designed to improve

their physical activity. Therefore it is possible that the total sedentary time of the average undergraduate student is higher than the numbers reported by Buckworth and Nigg (2004). However, the researchers' note that the sample was typically physically active when first enrolled in the classes and self-reported that they were consistently physically active for almost 2 years. This gives further merit to the idea that undergraduate students can be highly sedentary and physically active at the same time. Secondly, the items included in the questionnaire designed to provide insight on sedentary behaviour only include 3 questions and focused on the areas of TV/videos, study, and computer use. While these are important areas, they neglect other domains of a student's life where sedentary behaviour is potentially prominent such as during meals, transportation, and occupations meaning school and paid work. Finally, based on the work of Macneela et al. (2012), the amount of time spent in study found by Buckworth and Nigg (2004) may be drastically low. Macneela et al. (2012) concluded that the average student spends 17.3 hours of time in classes, labs and tutorials and an additional 10.6 hours in private study time in a week. Buckworth and Nigg (2004) do not provide a definition of what is meant by "study" which leads to the question of whether this definition would include both time spent at school in classes and private study time. Unfortunately, based on the evidence provided by the authors, this question cannot be answered.

Fountainne, Liguori, Mozumdar, and Schuna (2011) collected a sample of 736 students from two Midwestern universities in the United States. Researchers recruited from two required wellness classes and 461 male and 275 females participated with 62.1% of them being in their first year of study. The researchers took measurements of height and weight, followed by administering an online survey for the purpose of collecting data on the students' physical activity and sedentary behaviour. Time spent in sedentary behaviour was measured by 3 questions designed by the authors and validated in unpublished pilot testing. Responses were

recorded in minutes and 24-hour recall was used. The 3 questions asked: “Yesterday, how much time, in minutes, did you spend in front of a screen? (This includes computer, television, video games, movies etc.)”, “Of your total screen time yesterday, how much of it, in minutes, was spent watching television?” and “Yesterday, how many minutes did you spend on school work outside of class? (i.e. homework)” (Fountainaine, Liguori, Mozumdar, & Schuna, 2011., p.105). The majority of the students in the sample (n=325) were insufficiently active and their results showed that time spent watching television was 63.09 minutes a day, overall screen time was 161.76 minutes a day, and time spent doing homework was 84.96 minutes a day. Again, while Fountainaine et al. (2011) make a valid contribution to the research area, similar criticisms can be made; recruiting students from a single course focused on wellness means that the sample was not representative of the whole student population and the students enrolled may have had a higher level of knowledge in the area of health, making them less sedentary than the average student. Similar to the questionnaire provided by Buckworth and Nigg (2004), the questions developed by Fountainaine et al. (2011) failed to extend to multiple domains of student life and only included information on a limited range of sedentary behaviour. Based on the information provided, total sedentary time of undergraduates cannot be determined. While these criticisms can be made, the majority of data collected by both Buckworth and Nigg (2004) and Fountainaine et al. (2011) belonged in the category of physical activity rather than sedentary behaviour.

In similar fashion to the two previously mentioned studies, Quartiroli and Maeda (2014) recruited college students at a moderately large mid Atlantic university. All of the students who participated were enrolled in the required Lifetime Physical Activity and Fitness class and received an extra credit for participating. A total of 875 students participated with a mean age of 20.29 years old. Students were provided with an online link to a survey that included the self-administered short form of the International Physical Activity Questionnaire (IPAQ). Of the 7

items, 6 measured physical activity and 1 measured sedentary behaviour. The results of the study are similar to Buckworth and Nigg (2004) and demonstrated that highly active students can still be highly sedentary, as participants in this study engaged in 6-7 hours of sedentary behaviour each day. Again, some problems can be identified. A student who is enrolled in a program that requires a student to take a physical activity class may be more motivated to live an active life and therefore will participate in significantly less sedentary behaviour than a student who does not meet physical activity guidelines. The level of sedentary behaviour of an average student on a university campus may be significantly higher than the results found by Quartiroli and Maeda (2014). In addition, providing students with extra credit for participating in the study could be recognized as coercion. Finally, the IPAQ questionnaire is more tailored towards physical activity and more diverse and accurate information will be acquired with the use of a questionnaire that was designed specifically for measuring sedentary behaviour.

Purpose and Hypothesis of the Current Study

The purpose of the current study is to assess the level of sedentary time of full-time undergraduate students at an urban Canadian university and to gain insight on student perceptions of the facilitators and barriers to reducing their own sedentary time. It is hypothesized that full-time, undergraduate students will participate in levels of sedentary time equal to that of full time, office based employees, putting them at risk for the development of serious chronic conditions.

Chapter 3: Methods

Participants and Recruitment

This cross-sectional study included a sample of full-time, male and female undergraduate university students from an urban Canadian university in the Fall semester of 2015. With approval by the Western University Research Ethics Board, the study took place from October 2015 to December 2015 on the Western University campus located in London, Ontario. Upon approval by the Western University Ethics Board, emails were sent to professors from various faculties explaining the purpose of the study and outlining all ethical requirements.

Approximately 400 individual emails were sent to professors in every faculty and spanning all years of enrollment in order to be as inclusive as possible and provide an average sedentary time that is generalizable to the entire undergraduate population. The email included the letter of information and a link to the survey on SurveyMonkey and asked permission to visit each professor's classroom in order to make a short announcement to their class extending an invitation to the students to participate in the study (note: professors were also informed of the ethical requirement that they leave the room while the announcement is made). The vast majority of professors did not respond and many of those professors who did respond rejected the request explaining that they were not comfortable leaving their classrooms for an announcement, that they would prefer to make the announcement themselves, and/or would be willing to post study information on their course websites; these were not options that were allowed by the Office of Research Ethics. Researchers visited 17 different classes and spoke to approximately 2700 students. Each in-class announcement invited students to participate in the study and ended with researchers providing students with an information card with the Co-investigators name, email and the survey link. In addition, announcements were made on faculty Facebook pages that were created and controlled by students. Announcements were made once a week for three weeks

inviting students in the groups to participate in the study with an attached link to the survey on SurveyMonkey. All participants were informed that all information collected during the study would remain confidential and no names or identities would be collected within the study.

Data Collection Tools

The online survey included parts A, B and C as outlined below:

Part A: Demographic Information. The demographic information (Appendix A) of participants was collected at the beginning of the survey. Information was collected on sex, ethnicity, program of registration, year of enrollment, living arrangements etc. The demographic questionnaire is provided in the appendix.

Part B: The SIT-Q Sedentary Behaviour Questionnaire. The SIT-Q (Appendix B) is a domain specific questionnaire that tracks the sedentary behaviour of adults in 6 domains: 1) sleeping and napping 2) meals 3) transportation 4) work study and volunteering 5) child care and elder care and 6) light leisure and relaxing. There is also a final section titled “final questions”. The items include categorical and continuous variables that allowed total daily sedentary time to be calculated for weekdays and weekends. The SIT-Q was developed and validated by Lynch and colleagues (2014) with total daily sitting time demonstrating fair to good correlation (ICC = 0.65, 95% CI: 0.49, 0.78). Other ICCs ranged from poor (0.31) for computer use during leisure time to excellent (0.86) for occupational sitting time. The researchers used Spearman’s correlation coefficient in order to establish convergent validity. Domain specific estimates of sedentary time were calculated from a first administration of the SIT-Q with average values from two administrations of a 7-day activity diary, which were completed 8 months apart (Lynch et al., 2014). Overall, the SIT-Q demonstrated moderate validity with total sitting time showing a Spearman’s correlation coefficient of 0.53. Despite its challenges, the SIT-Q was chosen as the primary methodological tool based on a number of its strengths. Various sedentary behaviour

questionnaires narrow attention to specific domains. Clark et al. (2009) focused on television viewing (leisure time), while Chau et al. (2012) studied sitting in the workplace (occupation). According to Owen et al. (2011), adult determinants of sedentary behaviour are different depending on what domain of life they occur in. In order to effectively study the sedentary behaviour of adults, methodological tools must meet this multi-domain need. This multi-domain need is met by the SIT-Q's unique design, spanning 6 domains and developed through the rigorous 3-stage process of expert review, cognitive interviewing, and pilot testing (Lynch et al., 2014). In addition, the SIT-Q is the most appropriate tool for the population of undergraduate students due to the included domain of work, study, and volunteering. The SIT-Q caters to the role of a student that other sedentary behaviour questionnaires have ignored. The SIT-Q has a total of 18 items with 16 of those items pertaining to the sedentary behaviour of the subject. The SIT-Q allowed for the collection of data that is much more diverse and comprehensive than other available, previously validated questionnaires used in sedentary behaviour research. The SIT-Q presented as the best, currently available validated sedentary behaviour questionnaire to investigate the sedentary behaviour of undergraduate students at an urban university in Canada due to its diverse items and included domains. This study served as a needs assessment in the first step of program planning to establish a critical starting point for interventions to reduce the sedentary behaviour of undergraduate students in Canada.

Part C: Student Perceptions of Facilitators and Barriers to Reducing Their

Sedentary Behaviour. The open-ended aspect of the study focused on understanding student perceptions of the facilitators and barriers to reducing their own sedentary behaviour. Following the SIT-Q, participants were asked to answer the two following questions: "What facilitators exist (at school, home, work, transportation) that aid in your ability to engage in a less sedentary

lifestyle?” and “What barriers exist (at school, home, work, transportation) that hinder your ability to engage in a less sedentary lifestyle?” These questions were answered in written form.

Exclusion Criteria

Unfortunately, a significant number of participants had to be eliminated from data analysis. A total of 335 participants responded to the online survey however the majority of these participants filled out the survey in a manner that excluded them from data analysis. Of the 335 participants, 191 did not fill out any information in Section 4 of the SIT-Q regarding “Study”, despite the fact that all participants were undergraduate university students. It would be highly inaccurate to include participants who are full-time undergraduate students and suggested through the completion of the SIT-Q, that they spend no time sitting during study in any week in the past year. An additional 42 participants were excluded from data analysis because of implausible sedentary times. According to a personal communication that occurred between Fraser and Lynch (2014), a total daily sedentary time of more than 18 hours a day is implausible and participants who exceed 18 hours should be eliminated from data analysis.

After all exclusion criteria had been met, a total of 102 participants were included in data analysis. Their demographic information, quantitative data from the SIT-Q and qualitative data from the open-ended questions are provided below.

Data Analysis

In order to score and analyze the results of the SIT-Q, sedentary behaviour was assessed separately for weekdays and weekends, except for work, study and volunteering. This domain was reported based on weeks per year, days per week and hours per day (Lynch et al., 2014). Due to the fact that participants did not work every day, the descriptive statistics for work, study and volunteering was summarized as hours or minutes in this domain per week (Lynch et al.,

2014). To calculate total sedentary time, minutes per day was be totaled and averaged (Lynch et al., 2014). All items measuring total sedentary time in each domain was completed with continuous variables through written responses. Items 8a, b, c, d, 13, and 14 are categorical variables and are to be measured using a 5-point Likert Scale and measure breaking up sedentary behaviour time.

To analyze the qualitative data, common themes expressed were identified and potential facilitators and barriers identified by the students were analyzed and recorded. Student responses from these open-ended questions underwent inductive content analysis (as described by Patton, 2002) in order to ensure that frequent answers are categorized into common themes.

Chapter 4: Results

The findings produced from quantitative and qualitative data are presented in this chapter. First, the demographic information for those participants included in the analysis is presented. Then, quantitative data from the online survey is illustrated through a series of statistical tables. Finally, qualitative data produced through two open-ended questions are explored and supporting quotations for each key theme identified through inductive content analysis is provided.

Demographic Information

More females ($n=81$, 79.4%) than males ($n=20$, 19.6%) were included in data analysis with the overwhelming majority of those students being Caucasian ($n=77$, 75.5%). The respondents ranged from 19 years and under ($n=37$, 36.3) to 30-34 years old ($n=1$, 0.98%) with the majority of respondents being 20-24 years of age ($n=63$, 61.67%). There was a rather even distribution of respondents included from each year of study with most enrolled in fourth year ($n=34$, 33.33%) and the largest portion from the Faculty of Health Sciences ($n=53$, 51.96%). The majority of students were unemployed ($n=61$, 59.8%) with the remaining students working part-time jobs ($n=40$, 39.21%) and one (1) working a full-time job. More students lived in London, Ontario for just the Fall and Winter semesters ($n=75$, 73.53%), while significantly less ($n=25$, 24.51%) lived in London, Ontario year round. The most common living arrangements was living off campus with roommates ($n=63$, 61.76%), followed by living on campus in residence ($n=19$, 18.63%) and off campus with relatives ($n=16$, 15.69%). Table 1 provides a summary of the demographic information of the full-time students who were included in the data analysis.

Table 1

Demographic Information (N=102)

Characteristic	n	%
Sex		
Male	20	19.61
Female	81	79.41
Other	0	0
Prefer not to disclose	1	0.98
Age		
19 and under	37	36.27
20-24	63	61.76
25-29	1	0.98
30-34	1	0.98
Ethnicity		
Aboriginal	0	0
African Heritage	1	0.98
Caucasian	77	75.49
East Asian	11	10.78
Hispanic	3	2.94
Middle Eastern	2	1.96
South Asian	3	2.95
Other	5	4.90
Program of Registration		
Health Sciences	53	51.96
Arts and Humanities	2	1.96
Engineering	11	10.78
Science	18	17.65
Social Science	16	15.69
Other	2	1.96
Year of Academic Enrollment		
First	14	13.72
Second	27	26.47
Third	17	16.67
Fourth	34	33.33
Fifth	9	8.82
Employment Status		
Full-time	1	0.98
Part-time	40	39.21

Unemployed	61	59.80
Place of Residence		
London, Ontario (fall and winter Semesters only)	75	73.53
London, Ontario (year round)	25	24.51
Outside London, Ontario	2	1.96
Living Arrangement		
On campus	19	18.63
Off campus alone	4	3.92
Off campus with roommates	63	61.76
Off campus with relatives	16	15.69

Quantitative Findings From the SIT-Q Sedentary Behaviour Questionnaire

The results from the quantitative analysis of the SIT-Q are reported in Table 2 and Table 3. The data is broken down into total sedentary time and is then followed by sedentary time on weekdays versus weekends and sedentary time during work, study and volunteering. This break down of the data provides information on each domain of the SIT-Q and shows how each domain contributed to the overall total sitting time. Students spent an average of 11.88 ± 3.46 hours per day engaged in sedentary behaviours. This total average includes time spent napping, eating meals, in transportation, doing work/study/volunteering, and participating in leisure activities. An average of 7.37 hours per day on weekdays and an average of 8.68 hours on weekends were spent sleeping. The most common sedentary behaviours were watching television (weekday: 1.40 hours/day, weekend: 2.51 hours/day) and computer use for leisure activities (weekday: 2.25 hours/day, weekend: 2.77 hours/day) while almost no time was spent caring for a child (weekday: 0.59 mins/day, weekend: 1.74 mins/day) or an elderly family member (weekday: 2.94 mins/day, weekend: 6.42 mins/day). Paired sample t-tests were performed to compare sitting times within each individual domain between weekdays and weekends. Sleeping, eating meals, watching TV, computer use and other leisure time were all significantly greater on weekends. The domains of napping and transportation were greater on weekdays but were not significantly different.

Table 2

Comparison of total sedentary time (hours/day \pm SD) on weekdays and weekends (N=102)

Sedentary Behaviour (hours/day)	Weekday <i>Mean \pm SD</i>	Weekend <i>Mean \pm SD</i>	p
Sleeping	7.36 \pm 1.10	8.68 \pm 1.11	<0.0001
Napping	0.32 \pm 0.58	0.23 \pm 0.55	0.1953
Meals	1.17 \pm 0.79	1.45 \pm 0.91	<0.0001
Transportation	0.85 \pm 1.15	0.73 \pm 0.81	0.3240
Child Care	0.01 \pm 0.10	0.03 \pm 0.22	0.3197
Elder Care	0.05 \pm 0.36	0.11 \pm 0.67	0.1583
Television Time	1.40 \pm 1.26	2.51 \pm 1.93	<0.0001
Computer Time	2.25 \pm 1.94	2.77 \pm 2.24	0.0010
Reading	1.08 \pm 1.23	1.39 \pm 1.52	0.0821
Other Leisure Pursuits	0.71 \pm 0.85	1.35 \pm 1.57	<0.0001
Total Sedentary Time	7.85 \pm 3.64	10.59 \pm 4.88	<0.0001

Table 3 presents the data obtained from Section 4 of the SIT-Q: Work, Study, and Volunteering. Students spent an average of 3.29 ± 1.71 hours per day engaged in sitting during work, study and volunteering. An average of 0.52 ± 0.82 hours/day was spent sitting during work, 2.70 ± 1.68 hours/day during study, and 0.050 ± 0.22 hours/day during volunteering.

Table 3

Total Sedentary Time (hours/day \pm SD) during work, study and volunteering (N=102)

Job	Mean \pm SD
Work	0.52 \pm 0.82
Study	2.70 \pm 1.68
Volunteering	0.050 \pm 0.22

Table 4 presents the average total sedentary time per day based on program of registration and employment status. The amount of sedentary time attributed to study for each program of registration is also provided. Total sedentary time was consistent throughout the different programs and whether a student was employed or unemployed had little effect. The time attributed to study per day was also consistent throughout the various programs.

Table 4

Total Sedentary Time (hours/day \pm SD) based on program and employment status

Demographic	Mean \pm SD	Time Attributed to Study
Program of Registration		
Health Sciences	11.84 \pm 3.35	2.72
Engineering	11.66 \pm 3.58	2.73
Science	11.86 \pm 3.54	2.69
Social Science	11.76 \pm 3.59	2.71
Arts and Humanities	14.83 \pm 2.21	1.76
Other	12.52 \pm 3.50	4.28
Employment Status		
Part-time	11.84 \pm 3.58	
Unemployed	11.86 \pm 3.54	

Qualitative Findings from Additional Open Ended Questions

Two opened ended questions at the end of the online survey were analyzed using inductive content analysis (Patton, 2002). A total of 145 students responded to these open ended questions and were included in the qualitative analysis. Students answered the following questions: 1) What facilitators exists (at school, home, work, transportation) that aid in your ability to engage in a less sedentary lifestyle? and 2) What barriers exist (at school, home, work, transportation) that hinder your ability to engage in a less sedentary lifestyle? The co-investigator and a trained senior undergraduate research assistant independently reviewed the responses in order to strengthen the confirmability of the qualitative analysis process (Guba and Lincoln, 1989). The responses were coded and key themes were identified for the facilitators and barriers of engaging in a less sedentary lifestyle. The lead researchers and research assistant met to discuss the themes which they agreed to unanimously. During this meeting, three themes were identified for facilitators and two themes were identified for barriers. Table 5 presents supporting quotations for the themes identified for facilitators and Table 6 presents supporting quotations for the themes identified for barriers (please note: no changes/edits were made to the punctuation or language of respondents. The three themes identified for facilitators were: access to the gym; student jobs; and walking to and on campus. The two themes identified for barriers were: sitting in class and studying outside of class.

Access to gym as a facilitator to aid in engaging in a less sedentary lifestyle. The majority of students who responded answered that the recreational center on campus helps them reduce their daily sedentary behaviour. Many students expressed that the center provides many classes, multiple exercise routines, and intramural sports. Additionally, multiple students stated that the close proximity of their home to the gym made getting there easier. They did not have to rely on a car or public transit in order to workout. Some students mentioned that having the gym

membership included in tuition helps them to reduce their sedentary behaviour while one student even mentioned that the gym membership was “free”.

Student jobs as a facilitator to aid in engaging in a less sedentary lifestyle. Many students provided that the jobs they work during school and in the summer months are jobs that require them to be standing or walking around. Students mentioned jobs as a server, volunteering at a hospital transferring patients, working in warehouses, and in labs where there is no chair for sitting. All jobs mentioned were jobs that typically do not require, or allow sitting while working other than during designated break times, with the exception of one student noting the use of a sit-stand desk at work to break up periods of sitting.

Walking to and on campus as a facilitator to aid in engaging in a less sedentary lifestyle. A large number of students expressed that they often walk to and from school. Some of these students noted that they live very close to school while others stated that they walk for long periods of time. When they are on campus, multiple students expressed that they have to walk across campus to get from one class to another because they often have classes in separate buildings. Others noted that they walk to the bus stop in order to get to school. Active forms of transport were reported as common among participants.

Table 5

Quotations Supporting Themes Identified as Facilitators That Aid in Engaging in a Less Sedentary Lifestyle

Access to the Gym

“I go to the gym at school 3 times per week”

“The gym is close to where I live. My university program promotes an active lifestyle. I have good friends that exercise regularly.”

“Intramural sports and other leagues. Gyms and athletic places in the vicinity of where I live”
“Gym close, I don’t have a car”

“I have a gym membership with Western that is included in my tuition.”

“Accessible gym facility”

“Free gym classes”

“Access to Gym at the university, Exercise routines available free and easily on the internet, transport to and from Gym.”

“gym being so close to where I live is motivation”

“School gym (having a gym easily accessible o campus motivates me to work out more/sit less)”

Student Jobs

“work (because my current job requires me to stand up)”

“Work- always on my feet helping customers”

“Work back of house at a computer store consistently bringing computers to and from the front of the house.”

“At the hospital and working in a warehouse requires you to be constantly walking to do the job.”

“- jobs that requires a lot of mobility, rather than sitting”

“Part-time work in a lab, I have no chair or desk to work at.”

“Sit-stand desks at work are great to break up extended periods of sitting!”

“working as a server you rarely get to sit, so that keeps me moving and not sedentary.”

“Volunteering at the hospital requires me to be transport patients at all time”

Walking to and on campus

“I have to walk most places on campus”

“distance between classes”

“walking to class because LTC sucks”

“ability to walk to class (close to campus)”

“University campus being large and having to walk from class to class”

“I walk to class for at least 1h 30m”

“Living close to school helps me be less sedentary because when I get to walk to school instead of sit on a bus.”

Note. This table contains the most relevant quotations. Multiple answers came in single word form or very limited responses such as “gym”, “walking to classes”, and “school, work, and extracurricular activities”.

Sitting in class as barrier to engaging in a less sedentary lifestyle. The majority of students identified that a large amount of their sedentary behaviour is related to the amount of time they spend sitting down during lecture. They expressed that when they are attending a lecture, there is no option other than sitting for the entire lecture with the exception of small breaks. However, some students noted that in longer lectures, breaks are not always provided. Some students phrased the problem as “limitations in the classroom” while other students expressed that “school makes you sit during class” and that they are “forced to sit in class”.

Studying outside of class as a barrier to engaging in a less sedentary lifestyle. A similar pattern exists with this barrier and the barrier mentioned above. Students identified that for those who wish to study on campus in the library, there are no options other than sitting. In addition, the majority of students identified that when they are studying at home, the only option that exists is to study while sitting down. Despite having some control over the environment at home students expressed that sitting during private study is “required”. A few students mentioned that they do not have access to a standing desk at home to solve this problem but many students responded with phrases suggesting that even if a standing desk was available, the work that needed to be completed could only be done while in a seated position. For others, sitting while studying is about comfort while others stated that it is about being able to focus.

Table 6

Quotations Supporting Themes Identified as Barriers to Engaging in a Less Sedentary Lifestyle

Sitting During Lecture

“school is usually sitting down during a lecture”

“There are no standing desks at school, all lecture halls have seats”

“limitations in the classroom”

“Having to sit in long lectures with breaks only in the middle – Studying time is the majority of my seated time.”

“forced to sit in lectures”

“Classes often in the same room or building...36+ hours a week of class, so 36+ hours a week spend sitting”

“Lecture halls with no option for standing desks or no moving breaks”

“Having no where to stand with a table during lectures...there’s no option to stand or stretch your legs”

“Lack of breaks during two hour lectures”

“regular lecture hall arrangement”

Studying Outside of Class

“A lot of work to do, and not many options are available to do this standing up comfortably. So much work to do, it is hard to leave it to stand up or walk somewhere. Feels like I am wasting time that could be spent doing homework.”

“I don’t have a standing desk at home for study.”

“ ‘Some work just has to be done sitting down’. For example, reading, writing an essay, etc.”

“I have a lot of readings, assignments, essays and other projects which require me to sit and focus in order to complete.”

“Almost all schoolwork needs to be completed sitting down.”

“Most work needs to be done at my desk.”

“A lot of work has to be done sitting down obviously and that takes a lot of time.”

“The only comfortable way to study is sitting down.”

“Heavy textbook readings Course content is all online (OWL)”

“sitting in desks – having lots of school work to complete at home – sitting in the library”

Note. This table contains the most relevant quotations. Multiple responses came in single word form or very limited responses such as “class” and “homework”.

Chapter 5: Discussion

The primary purpose of this study was to identify the total daily sedentary time of full-time undergraduate students at an urban Canadian university and to explore facilitators and barriers to engaging in a less sedentary lifestyle. The previous studies focusing on sedentary behaviour were largely focused on children, working adults, and older adults. The limited studies focusing on the sedentary behaviour of undergraduate students (Buckworth and Nigg, 2004; Fountaine, Liguori, Mozumdar, and Schuna, 2011; Quartiroli and Maeda, 2014) obtained significantly more participants than the current study, but recruited from physical activity classes and collected data from limited lifestyle domains thus limiting the accuracy of the data. Fraser (2014) studied the sedentary behaviour of undergraduate students as it related to their nutrition habits but recruited from a single nutrition class, narrowing the generalizability of the data and the research lacked a qualitative aspect, which would have provided valuable insight on student perceptions. To our knowledge, ours is the first study completed in Canada to investigate the sedentary behaviour of university students across different faculties and years of enrollment, attempting to establish a total sedentary time to be generalized across the entire undergraduate population. In addition, it was the first study to collect qualitative data on students' perceptions of facilitators and barriers to their sedentary behaviour.

It was hypothesized that undergraduate students would have sedentary behaviour levels that equal or surpass desk-based working adults and they should therefore be targeted for intervention. When compared to other findings on the sedentary behaviour levels of adults (Rosenberg et al., 2010), this hypothesis is true. Rosenberg et al. (2010) found their sample of 842 men and women had a total weekly sedentary time of 65.6 hours or 9.4 hours a day, which is 2.48 hours less than the undergraduate students of the current study. Rosenberg et al. (2010) used the Sedentary Behaviour Questionnaire (SBQ) as their measurement tool which explored similar

domains as the SIT-Q with the major difference being that the SBQ does not include information on “study”. The SBQ compares sedentary time on weekdays and weekends making it a very reasonable comparison to the data retrieved from the SIT-Q. Rosenberg et al. (2010) found that the average sedentary time on weekdays was 9.65 hours/day and weekends was 9.8 hours/day. The current study found an average total sedentary time of 7.85 hours/day on weekdays and 10.95 hours/day on weekends. However, these numbers do not include the 3.29 hours/day allocated to work, study, and volunteering because of the differences in the scoring protocol between the SIT-Q and the SBQ. While the current study demonstrated that undergraduates spend more time sedentary than adults, it was unable to demonstrate that they spend similar amounts of time sitting when engaged in work versus study and therefore the findings only partially support the initial hypothesis.

The data of the current study demonstrates that the total sitting time attributed to study of an undergraduate student is much less than the sitting time of office based employees when at work (Alkhajah et al., 2012). The current study found that students spend an average of 2.7 hours of their daily sedentary time engaged in study (lecture and private study) while Alkhajah et al. (2012) found that office based employees sit for 6 hours during their work day. The daily sedentary time allocated to study was consistent between faculties with the exception of “Arts and Humanities” (2 participants) and “Other” (2 participants). With a larger sample of participants it may be found that certain faculties have a greater amount of sedentary time allocated to study than other faculties due to the amount of time spent sitting in class. From an intervention perspective, it would have been beneficial to know what proportion of a student’s study time is spent in a classroom compared to at home or in a library. When compared to the findings of other studies on undergraduate sedentary time, the current study’s total daily sedentary time of 11.88 hours per day is consistent with the findings of Fraser (2014). Fraser

(2014) found that undergraduate students enrolled in a nutrition class at Guelph University had a total daily sedentary time of 11.80 hours per day. Looking at studies completed in the United States, Buckworth and Nigg (2004) found a total daily sedentary time of 29.72 hours per week or 4.25 hours per day, while Quartiroli and Maeda (2014) reported an average sedentary time of 6.37 hours per day. The average sedentary times collected south of the border are significantly less than what was found in this study, however, these studies looked at limited domains mostly involving leisure time and therefore do not provide an accurate total sedentary time for the population. Fountaine, Liguori, Mozumdar, and Schuna (2011) included homework in their total sedentary time and found that students spent an average of 1.6 hours/day sitting while doing homework. This figure does not include time spent in class but it can be compared to the 2.7 hours per day that students in this study spent sitting during all study. With the exception of Fraser (2014), the previous studies examining the total sedentary time of undergraduate students appear to underestimate the total sedentary time when compared to the results of the current study. However, it is possible that the daily sedentary time of 11.88 hours that was found in the current study is also much lower than the true daily sedentary time of undergraduate students and the 2.7 hours per day allocated to study time is also underestimated. This is due to the scoring protocol of the SIT-Q and the exclusion criteria of implausible sitting times of 18 hours a day.

Like every domain included in the SIT-Q, the study, work and volunteering section is calculated for the entire year. For most of the population, this makes logical sense as an individual could work, volunteer and attend classes at any point throughout the year. However the study aspect of this domain is problematic when calculating the average time an undergraduate student spends sitting in the past 365 days. This is because the average student is enrolled in classes from the beginning of September to the end of April. For example, one participant stated through their answering of the SIT-Q that in the past year they were sitting for

the purpose of study for 32 weeks, 7 days per week, and for 6 hours a day, equaling a total of 1,344 hours over the entire year. Recalculating this for each day over the past year, the student spent 3.68 hours each day sitting during study. This daily average is essentially “watered down” because of the approximately 16 other weeks in which the student is not attending classes or privately studying. It does not make sense to calculate a student's sitting time during study at a time when the student is not in school. The current study found that 2.7 hours a day were spent sitting while engaged in study but due to this flaw in the scoring protocol for this specific population, it is estimated that the true number is significantly higher for the time a student is actually in school and not off for the summer months. The true average of sitting time allocated to study each day for a student could be much closer to the 6 hours a day office workers spend sitting reported by Alkhajah et al. (2010) and therefore makes the study environment a potential for intervention.

In addition to the underestimated daily sedentary time allocated to study, it is possible that the total daily sedentary time for the undergraduate population of the current study is also lower than the true average. The exclusion criteria put forth by the creators of the SIT-Q for implausible sitting times of 18 hours or more a day is a reasonable one. Some participants who were excluded from data analysis reported daily sitting times of greater than 24 hours in a day. They either over estimated time spent in each domain or they double counted time spent between two or more of the domains or did not understand the questions being asked. A participant could have counted an hour of television time while eating in front of the TV as 2 hours of sitting time and therefore double counted that time. Of course, it is impossible for a participant to sit for more than 24 hours in a day and it may even be impossible for them to sit for 18 hours a day when considering they must have spent some time sleeping. We can definitively say that it is impossible for these times to be accurate. This exclusion criterion must exist in order to prevent

a gross exaggeration of total daily sedentary time. However, no exclusion criteria for the opposite exists. Of the 102 participants included in the data analysis some reported sedentary times of a lower nature that are arguably unlikely. Although it is possible to have an average daily sitting time of 2 or 3 hours over the past year, and we cannot say with the same certainty as the previously mentioned exclusion criteria that it is impossible, but it is unlikely. Due to the exclusion criteria for participants who had implausible sitting times for high levels of daily sitting time but including those participants who reported less likely lower sitting times, it is estimated that the undergraduate average sedentary time is greater than what was found in the current study.

Undergraduate students confirmed that having access to a recreational facility aided in their ability to live a less sedentary lifestyle. This theme is interesting because it raises the question of whether the undergraduate population is aware of the new found distinction between exercising too little and sitting for too long that was mentioned much earlier in this paper. Does 11.88 hours a day spent engaged in sedentary behaviours outweigh the physical benefits of having access to a gym? It is easy to assume that if we get our required 150 minutes of moderate to vigorous physical activity per week that we are doing all we need to do and time spent working out is not time spent lying on a couch. However looking back at the 2008 study completed by Pate et al., they found that it is possible for an individual who reaches this physical activity goal to still be highly sedentary and therefore be at risk for health problems. Kulinski et al. (2014) conducted a study demonstrating that 6 to 7 hours of sitting time can negate the effects of an hour of exercise. Having access to the gym may facilitate the living of a less sedentary lifestyle but undergraduate students must do more than meet the Canadian Physical Activity Guidelines to do so. It is unclear at this point whether or not this is popular belief among the undergraduate population. However, there should continue to be a high level of access for undergraduates to campus recreational facilities and they should be encouraged to use their membership. Based on

the findings of Irwin (2004), 50% of the undergraduate population does not exercise enough to receive health benefits and students who lived off campus were more active than those living on campus, going against the notion that those who have the greatest access to the gym are more likely to use it. Access to a gym on its own cannot make an undergraduate student live a less sedentary lifestyle, but it certainly helps.

The second facilitator identified as aiding in a less sedentary lifestyle was student jobs. The types of jobs students work while they are in school or during the summers may typically be jobs where employees are required to be on their feet. The results of the current study did not show much of a disparity between the total sitting time of a student who works a part-time job (11.84 hours/day) versus a student who is unemployed (11.86 hours/day). These results go against what we would expect based on the nature of student jobs and may be a product of the low number of participants in the study. However it is unclear whether students who work a part-time job and stands for their shift will compensate by being highly sedentary after they have finished work. A student who is unemployed and has more time to be active may do so because they are not tired and sore from standing at work. Mummery, Schofield, Steele, Eakin and Brown (2005) studied the sitting time of Australian workers across 3 different occupational categories: professional, white-collar, and blue-collar. They found that blue-collar workers on average spent 136.1 minutes per day sitting compared to 207.1 minutes per day for white-collar workers and 248.8 minutes per day for professionals. For adults who work as professionals or white-collar workers, effective interventions to reduce sitting time would best be implemented within the workplace. For the majority of undergraduate students, the jobs they work are more comparable to blue-collar workers and therefore the student workplace can be ignored due to the low level of sedentary behaviour that is typically required with student jobs. The current study found that undergraduate students spend only about 30 minutes a day sitting while at work. The

greatest chance for change in a student's sedentary time is within the domain that the student spends the most time sitting. Effective interventions need to be placed within the study domain with greater emphasis on the classroom.

The third facilitator identified by students was walking to and on campus. A 2011 Undergraduate University Student Survey conducted by Prairie Research Associates found that 22% of students used walking as their main mode of transportation to campus with about half of students living within a 20 minute commute of the campus. Students are less likely to walk to campus as they continue into the upper years of study. They are more likely to drive a car alone or use public transportation because after the first year of study, students tend to move out of on-campus residences and into off-campus residences (Prairie Research Associates, 2011). Logically, the further a student lives from campus the less likely he/she are to walk and turn to modes of transportation such as public transit. Twenty-six percent of students surveyed used public transportation and according to Ly (2015) this does not necessarily mean that students who used public transportation are not active compared to those students who do not. Students often have to walk from their homes to the bus stop and then again from the bus stop to the building on campus where a lecture is being held. Ly (2015) found that when students are provided with discounted transit passes they may increase their physical activity levels during their daily commutes. Students who completed the questionnaire in the Ly (2015) study noted that they rarely use public transit for short distances. Universities should continue to maintain and even enhance their discounted transit programs in order to encourage students to stay away from individual transport and decrease student sedentary time. For students living within walking distance of the campus, students could benefit from visual cues, perhaps reminding them how far of a walk it is to campus from their residential location. For example, on popular bus stops and in student neighborhoods, a visual cue could promote the message "you are only a 10 minute

walk from campus and the bus is crowded. Take a walk.” Of the three facilitators identified by undergraduate students, walking to and on campus has the greatest potential to positively change the sedentary behaviour profile of a student. This is supported by the work of Levine, Vander Weg, Hill and Klesges (2006) where they note the importance of Non Exercise Activity Thermogenesis (NEAT), which is the energy expenditure of all physical activities other than sports, and dedicated exercise and the positive effect it has on health, completely separate from the benefits of MVPA. For those students living too far from campus to walk, they should be encouraged to use the discounted transit pass that was provided to them, and decrease their sedentary behaviour. It is important to remember that while travelling on a bus a student may not be increasing their physical activity but depending on if the student stands during travel, they could effectively be reducing their sedentary behaviour based on their personal characteristics, keeping in mind the work completed by Mansoubi et al. (2015). Students identified that they also break up their sedentary time by walking from place to place on campus. Western University and many other schools within Canada are big enough that they require a fair walk from one side of the campus to the other but not large enough to require a shuttle, giving students a break from sitting after a class that could have lasted 3 hours. It is possible that a student could take a bus from one stop on campus to another but this is complicated by infrequent bus pick up times. For now, walking on campus is the only viable option. During winter months, universities should continue to improve the upkeep of the grounds and where they exist, students should be aware of and encouraged to use the underground tunnels that exist between certain buildings to promote walking and further decrease sedentary behaviour.

Through the second open-ended question, students identified that a major barrier to them engaging in a less sedentary lifestyle is the amount of sitting they do when in class. This is a difficult barrier to address because students have no control over the environment on campus. At

this time they are limited to the breaks provided by the instructor during 2 and 3 hour lectures which according to student responses, do not always happen. Ideally, students would have the choice to sit or stand during lectures. The retrofitting of an entire existing lecture hall to contain sit-stand desks would be overly expensive. In addition, the lay out of the room would have to be altered in a way that would prevent a student who prefers to sit from being seated behind a student who decides to stand. To provide students with the power to control their own health, sit-stand desks could be installed in new buildings and lecture halls where decisions on in class materials and layouts have not been finalized. To save money and pilot-test student perceptions on the sit-stand desks, they could be installed in only the back row of the classroom allowing students to not worry about their line of sight to the lecturer from being obstructed. The average daily time spent sitting during study was 2.7 hours a day making it the highest sedentary domain meaning that an effective intervention has the potential for big change. However, this change also needs to occur outside of the classroom.

The second barrier identified by students was sitting while studying outside the classroom. Unlike the first barrier, students have some control over the environment they study in at home. However some student responses suggested that the students do not feel that some studying and computer use is possible in a standing position. Some respondents indicated that studying requires sitting. This perception may be changed with greater promotion of sit-stand desks at home. Hedge and Ray (2004) found that when employees were given a sit-stand workstation the employees increased the amount of time they spent standing from 8.3% to 21.2% of their workday. This decrease in sitting time resulted in a 27.5% decrease in musculoskeletal discomfort. Not all students can afford a sit-stand desk and for those who already have a perfectly good desk, they probably aren't going to spend hundreds of dollars just to be able to stand. However for a student transitioning from living in residence to living in a house with

roommates and who might be buying a new desk anyway, they should know the benefits of owning a sit-stand desk. For those who cannot afford to have a sit-stand desk, having the knowledge on taking effective breaks from sitting during study could be just as effective for certain aspects of their health. Although an optimal sit to stand ratio has not yet been established (Karakolis and Callaghan, 2014), Thosar, Bielko, Mather, Johnston and Wallace (2015) found that 3 hours of sitting resulted in significant impairment of the superficial femoral artery but when light activity breaks were introduced every hour during sitting, the impairment was prevented. In addition, sit-stand desks could be installed in a library where a view to lecture content is irrelevant and their use can be studied effectively.

Limitations

The greatest limitation faced by the current study is the low number of participants included in the quantitative data analysis. We attempted to obtain an accurate estimate of the total daily sedentary time that was generalizable to the entire undergraduate population but due to the recruitment limitations imposed, this was challenging. Despite our best efforts to recruit from multiple faculties, the majority of our participants were recruited from the Faculty of Health Sciences, which could have lead to self-selection bias. Health Science students may have been aware of the dangers of sedentary behaviour and therefor lowered the total samples average like previously mentioned sedentary behaviour studies. Specifically recruitment could take place through an in-person announcement only (no website postings) at either a designated break in class or at the end of class once the professors had dismissed the class and instructors could not be present in the room while the announcement was made. These recruitment limitations greatly reduced the initial responses from professors and the number of students who participated in the survey. Other useful analyses could have been performed with a larger sample size and

comparisons between males and females, as well as other demographics would have provided the researchers with valuable information.

A second limitation was the survey tool used in the current study. Although the SIT-Q Sedentary Behaviour Questionnaire is an adequate tool for measuring the sedentary behaviour of a general population, the current study may have been more successful with a measurement tool that was designed specifically for undergraduate students. As mentioned earlier, the SIT-Q may have greatly under-calculated the total daily time a student sits during study because it is a past-year measure and does not focus on the approximately eight months a student spends in school. In addition 42 students had to be excluded from data analysis and it is estimated that a proportion of these exclusions were due to students double counting their sedentary time and thus resulting in implausible sitting times. Although the instructions state that participants are to count sedentary time separate for each domain, this assumes that an average participant is going to read all the instructions provided. The current study may have found greater success if double counting could have been avoided in the design of the questionnaire rather than relying on participants thoroughly reading the questionnaire's instructions. Finally, the creator's instructions stated that a blank space was to be counted as a "0" and assumed that the question asked did not apply to the participant. However, this made it difficult to determine whether a student had left a question blank because it did not apply to them or if they simply became bored of the questionnaire and stopped filling out responses altogether.

A much more accurate method of measuring any individuals sedentary time is the use of an inclinometer and accelerometer. With these tools a researcher is able to accurately collect information on energy expenditure as well as posture. When analyzing the responses of a sedentary behaviour questionnaire, the only information a researcher is able to collect is whether or not the individual was sitting during a task. According to the study completed by Mansoubi et

al. (2015) mentioned earlier, it is possible for certain individuals to expend less than 1.5 METs when standing. With the information collected from the SIT-Q, it is possible that an individual did not provide any information within a certain domain because they stand for that certain task, and therefore lowered their reported total sedentary time. However, when considering the work of Mansoubi et al. (2015) and the individual's personal characteristics, the time spent standing could be sedentary time. The current study would have found greater success if we were able to use the best objective tool of an inclinometer and accelerometer, providing researchers with a more detailed picture of the total sedentary time of the undergraduate population. Due to the size of the studied population and the design of the current study, financially this was not an option.

Future Directions

Despite the challenge of generalizability of the results to the entire undergraduate population, the current study makes a meaningful contribution to the study of undergraduate student's sedentary behaviour. First, regardless of a student's total sedentary time, a student spends a large fraction of their time sitting in a university classroom because there is no option other than sitting. Despite the results of the current study, it is still predicted that in certain faculties, students will have a greater amount of sedentary time allocated to class time. This may be more problematic for some students than others depending on their faculty of study. Logically, if a student has 32 hours of class each week and is dedicated to going to every class, they will be spending 32 hours of their week sitting in addition to time spent sitting in other domains of life. While this may be more typical of a student in engineering or the sciences, for example, students in other faculties will still spend a significant proportion their weekly sitting time in a university classroom as well. Future research and studies should focus on the

plausibility of installing sit-stand desks into university classrooms and studying the perception of their use by undergraduate students. Studies should focus on how often a student uses a sit-stand desk in a standing position and measure the student's physical health and productivity when using the desk. The World Health Organization (1986) defines health promotion as "the process of enabling people to increase control over, and to improve, their health. It moves beyond a focus on individual behaviour towards a wide range of social and environmental interventions" and decreasing sedentary behaviour is no exception. Through environmental changes on university campuses, research can serve to increase the health of the undergraduate students, an important sub-group of the population in order to increase the health of all Canadians.

Conclusion

The results from this study provide a baseline for future research on the sedentary behaviour of undergraduate students. Although the findings suggest that undergraduate students are highly sedentary and a substantial amount of that time is dedicated to study in and out of the classroom, additional research is needed to determine an accurate amount of sedentary time that can be generalizable to the entire undergraduate population.

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Appendix A: Ethics Approval Notice



**Western
Research**

Research Ethics

**Western University Non-Medical Research Ethics Board
NMREB Delegated Initial Approval Notice**

Principal Investigator: Dr. Jennifer Irwin
Department & Institution: Health Sciences, Western University

NMREB File Number: 107160

Study Title: An assessment of sedentary time among undergraduate students at an urban Canadian university

Sponsor:

NMREB Initial Approval Date: October 10, 2015

NMREB Expiry Date: October 30, 2016

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Instruments	Additional Questions	2015/09/03
Instruments	SIT Q 8	2015/09/03
Instruments	Demographic Information	2015/09/03
Revised Letter of Information & Consent		2015/09/16
Revised Western University Protocol		2015/10/20

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the NMREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Ethics Officer, on behalf of R. Day Hinson, NMREB Chair or delegated board member

Ethics Officer to Contact for Further Information: Erika Basile ___ Nicole Ksniiki ___ Grace Kelly ☒ Mina Mekhail ___ VIKI Tins ___

This is an official document. Please retain the original in your files.

Appendix B: Invitation Email to Course Instructors

Subject Line: Survey on Undergraduate Students' Total Sedentary Time

Hello Professor,

I am writing to request your assistance for my MSc thesis project on undergraduate students' sedentary behaviour. I am wondering if I could make a quick announcement at some point before November 30, 2015 during your undergrad class(es) at a time that would be convenient for you to have a break in the class. The Office of Research Ethics has instructed me that I am to request that faculty step out of the room during the announcement, out of their concern that students may feel pressure to participate otherwise. Below is the formal recruitment information that I will be presenting to students, and that has been approved by the Office of Research Ethics. Thank you for your consideration.

Researchers from the Faculty of Health Sciences are conducting a study to assess Western undergraduate students' total sedentary behaviour time on an average day. Sedentary behaviour is any behaviour that involves sitting or lying down and includes goal-oriented behaviours such as working at a computer or attending a university lecture. In this study, full-time undergraduate students will be asked to participate in an online survey that will total their average daily sedentary behaviour time as well as their perceptions on facilitators and barriers that aid and hinder their ability to reduce their total daily sedentary behaviour time.

The online survey will take approximately 5 - 10 minutes to complete and will gather valuable information on the total daily sedentary behaviour time of undergraduate students and their perceptions on how to best reduce this total time. The link to the survey is:

<https://www.surveymonkey.com/r/THL8ZBM>

Thank you for considering our request. We would be happy to share the survey with you beforehand, and share the results with you after the study is completed. If you have any questions and/or require further information about this study, you are welcome to contact Marc Moulin

██████████ or Dr. Jennifer Irwin ██████████

Best regards,

Marc Moulin, MSc. Student in Health and Rehabilitation Sciences

Appendix C: Letter of Information

**An Assessment of Sedentary Time Among Undergraduate Students at an Urban Canadian University****Investigators:**

Jennifer D. Irwin, PhD, Faculty of Health Sciences, Western University

Marc Moulin, Faculty of Health Sciences, Western University

Purpose of Study:

The purpose of the proposed study is to gain valuable knowledge on the sedentary time of full-time undergraduate students at Western University. The objectives are to distribute the SIT-Q sedentary behaviour questionnaire to Western University full-time undergraduate students through email in order to quantitatively measure total average daily sedentary time and then to qualitatively assess facilitators and barriers to reducing sedentary time on campus and at home with an additional 2 questions which will be answered in written form.

Voluntary Participation:

Participation in this study is voluntary. If you choose to participate, you are able to leave any question unanswered, should you choose to do so, and still complete the remainder of the questionnaire. You may withdraw from the study at anytime without any penalty. Your participation in this study will have no impact on evaluations of you of any kind, academically or otherwise.

If You Decide to Participate:

If you decide to participate in this study, you will be asked to complete a 10 minute online survey through SurveyMonkey®. By accessing and completing the survey, you are providing implied consent to participate. Please note that the survey is located on Survey Monkey, which is hosted on United States' servers and as such, is subject to the United States Patriot Act. All information collected is confidential.

Confidentiality:

No names or identifiers will be collected within the study and information gathered will only be used for publishing or presentations purposes. Data collected from this study will only be accessible by the investigators and will be safeguarded on password protected devices, which will be destroyed after 5 years.

Cost and Compensation:

There is no cost to participate in this study. No compensation will be given for participation in this study.

Risks & Benefits:

There are no known risks for participating in this study. Your participation in this study will provide researchers with valuable information about Western students' total daily sedentary time and their perception's on the facilitators and barriers associated with reducing that total amount of time.

Feedback from the Study:

If you wish to receive the results from this study, please send an e-mail to Marc Moulin at [REDACTED]. If you have any questions and/or require further information about participating in this study, you are welcome to contact Dr. Jennifer D. Irwin [REDACTED] or Marc Moulin [REDACTED]. If you have any questions about your rights as a research participant, please contact Western's Office of Research Ethics at [REDACTED] or [REDACTED].

Faculty of Health Sciences
Arthur and Sonia Labatt Health Sciences Building, Room 200
London, Ontario, Canada, N6A 5B9
Tel: [REDACTED]

Appendix D: Demographic Information

Demographic Information

This section contains questions about your background and personal information. Please select the most appropriate answer relevant for you, personally, for each response.

1. Sex:

☐ Male☐ Female☐ Prefer not to disclose☐ Other, please specify: _____

2. Age:

☐ 19 years and under☐ 35-39 years☐ 20-24 years☐ 40-44 years☐ 25-29 years☐ 45-49 years☐ 30-34 years☐ 50 years and over

3. Ethnicity:

☐ Aboriginal☐ Hispanic☐ African Heritage☐ Middle Eastern☐ Caucasian☐ South Asian☐ East Asian☐ Other, please specify: _____

4. Current student's enrolment status at Western University:

☐ Part-time☐ Full-time

5. Program of registration:

☐ Faculty of Arts and Humanities☐ Faculty of Law☐ Faculty of Education☐ Faculty of Music☐ Faculty of Engineering☐ Faculty of Science☐ Faculty of Health Sciences☐ Faculty of Social Science☐ Faculty of Information and Media Studies☐ Other, please specify: _____

6. Year of academic enrollment:

☐ First☐ Second☐ Third☐ Fourth☐ Fifth☐ Other, please specify: _____

7. Employment status:

- ☐ Not employed ☐ Part-time ☐ Full-time

8. With regards to your place of residence:

- ☐ I live in London, Ontario during the Fall and Winter semesters
☐ I live in London, Ontario during the Fall, Winter, and Summer semesters
☐ I do not live in London, Ontario

9. My living arrangement is:

- ☐ On campus (i.e., residence) ☐ Off-campus with roommates
☐ Off-campus by myself ☐ Off-campus with family or relatives

Appendix E: SIT-Q Sedentary Behaviour Questionnaire

SIT-Q

Instructions:

- These questions are about the usual amount of time over the past 12 months that you spent sitting or lying down.
- The amount of time you spent sitting or lying down may have varied over the past 12 months. Do your best to estimate your usual pattern over the past 12 months.
- If you did not participate in a particular sitting task, please write “0” in the time response field.
- For each of the sitting tasks only count the time where this was your main focus. For example, if you spent one hour sitting on the sofa reading a book while you had a CD on in the background, count this time as one hour reading (do not also ‘double count’ as one hour listening to music).

If you have any questions please contact

Telephone:

Email:

ID

The SIT-Q is organized into seven sections, each asking about sitting or lying down in different settings.

Section 1 – Sleeping and Napping.....	3
Section 2 – Meals	4
Section 3 – Transportation	5
Section 4 – Work, Study and Volunteering.....	6
Section 5 – Childcare and Elder Care	11
Section 6 – Light Leisure and Relaxing.....	12
Section 7 – Final Questions	14

SECTION 1 – SLEEPING AND NAPPING

Sleeping and napping are an important part of your daily routine.

If you do shift work or you have variable sleeping patterns, please try to estimate the average number of hours in your sleep period, whether this is during the night or day.

SLEEPING

Think about how many hours you usually slept each night over the past 12 months.

Please record how long you usually slept on weekdays and weekends. This may include time you spent lying quietly while waiting to fall asleep, or after awakening.

1. How long did you usually sleep
per night?

*(include time spent lying quietly while waiting
to fall asleep, or after awakening)*

__hr __min __hr __min
(weekday) (weekend)

NAPPING

A nap is a brief sleep, often during the day. A nap can be taken in a chair as well as in a bed.

Did you take a nap each day, on either weekdays or weekends, over the past 12 months?

➔ If no, please write “0” in the response section, below.

2. How long did you usually nap

per day?

(do not include occasional naps)

__hr __min

(weekday)

__hr __min

(weekend)

SECTION 2 - MEALS

Eating is a task we don't often think about, but it can take up quite a bit of time each day.

Please think about the amount of time you usually spent sitting for meals over the past 12 months:

- do report times when your main focus was eating, including eating out
- do report the amount of time you spent between sitting down and being finished with a meal (leaving the table)
- do not include time spent preparing food
- do not include times you were eating while doing other things, like snacking while watching TV (you will be asked about this later).

3. How long did you usually spend
sitting for meals per day?

__hr __min __hr __min

(weekday)

(weekend)

SECTION 3 – TRANSPORTATION

This section refers to the time you spent sitting during transportation (travelling in a car, bus, train, etc.) in the past 12 months:

- do report time spent as either a driver or a passenger
- do report time spent commuting to and from work
- do not report time spent sitting during transportation as part of your job (you will be asked about this later)
- do not include occasional travel such as holidays
- do not include transportation on motorcycles, scooters or bicycles.

4. How long did you usually spend
sitting during transport per day? ____hr ____min ____hr ____min
(weekday)(weekend)

SECTION 4 – WORK, STUDY AND VOLUNTEERING

“Work” refers to your occupation or your job - all tasks done to earn money or make a living. You may work full-time or part-time; you may work for a company or be self-employed.

“Study” refers to formal educational activities related to school, technical college or university.

“Volunteering” refers to work that you do for no pay, such as helping at a hospital, church or sports club.

Please complete one response section for each type of work, study or volunteering you did in the past 12 months:

- there is space to record up to four different types of work, study or volunteering you may have done over the past 12 months

- do include the usual amount of time that you spent sitting down as part of your work, study or volunteering
- do not record holiday time here, even if it is paid vacation.

➔ If you did not do any work, study or volunteering in the past 12 months, please skip to **Section 5** on page 11.

Choose type of “job”: ☐ work ☐ study ☐ volunteering

Please name Job #1: _____

5a. How many weeks in the past 12 months did you do Job # 1? ___ weeks

6a. How many days per week did you do Job # 1? ___ days

7a. How much time per day did you spend sitting for Job # 1? ___hr ___min

*(include driving and travelling while doing this job;
do not include time commuting to and from this job)*

Think about the total time you spent sitting during Job # 1. We are interested in how often you stood up and moved around to “break up” the time you spent sitting. For example, you might have taken short walks to get a drink of water, to collect a document from the printer or to talk to someone else in the office.

8a. How often did you “break up” the time you spent sitting in Job # 1?

☐ ☐ ☐ ☐ ☐
(less than hourly) (hourly) (half hourly) (every 10 mins) (every 5 mins)

OR ☐ I did not sit for more than 30 minutes in a day

➔ Did you have any other work, study or volunteering “jobs” in the past 12 months? If so, continue on the next page.

➔ If you did not have any other jobs, please skip to **Section 5** on page 11.

Choose type of “job”: ☐ work ☐ study ☐ volunteering

Please name Job #2: _____

5b. How many weeks in the past 12 months did you do Job # 2? ___ weeks

6b. How many days per week did you do Job # 2? ___ days

7b. How much time per day did you spend sitting for Job # 2? ___hr ___min
*(include driving and travelling while doing this job;
do not include time commuting to and from this job)*

Think about the total time you spent sitting during Job # 2.

8b. How often did you “break up” the time you spent sitting in Job # 2?

☐ ☐ ☐ ☐ ☐
(less than hourly) (hourly) (half hourly) (every 10 mins) (every 5 mins)

OR ☐ I did not sit for more than 30 minutes in a day

➔ Did you have any other work, study or volunteering “jobs” in the past 12 months? If so, continue on the next page.

➔ If you did not have any other jobs, please skip to **Section 5** on page 11.

Choose type of “job”: ☐ work ☐ study ☐ volunteering

Please name Job #3 _____

5c. How many weeks in the past 12 months did you do Job # 3? ___ weeks

6c. How many days per week did you do Job # 3? ___ days

7c. How much time per day did you spend sitting for Job # 3? ___hr ___min
*(include driving and travelling while doing this job;
do not include time commuting to and from this job)*

Think about the total time you spent sitting during Job # 3.

8c. How often did you “break up” the time you spent sitting in Job # 3?

☐ ☐ ☐ ☐ ☐
(less than hourly) (hourly) (half hourly) (every 10 mins) (every 5 mins)

OR ☐ I did not sit for more than 30 minutes in a day

➔ Did you have any other work, study or volunteering “jobs” in the past 12 months? If so, continue on the next page.

➔ If you did not have any other jobs, please skip to **Section 5** on page 11.

Choose type of “job”: ☐ work ☐ study ☐ volunteering

Please name Job #4 _____

5d. How many weeks in the past 12 months did you do Job # 4? ___ weeks

6d. How many days per week did you do Job # 4? ___ days

7d. How much time per day did you spend sitting for Job # 4? ___hr ___min
*(include driving and travelling while doing this job;
do not include time commuting to and from this job)*

Think about the total time you spent sitting during Job # 4.

8d. How often did you “break up” the time you spent sitting in Job # 4?

☐ ☐ ☐ ☐ ☐
(less than hourly) (hourly) (half hourly) (every 10 mins) (every 5 mins)

OR ☐ I did not sit for more than 30 minutes in a day

SECTION 5 – CHILDCARE AND ELDER CARE

This section refers to the time you spent sitting while taking care of your children, grandchildren or elderly family members.

Were you involved in childcare or elder care each day, on either weekdays or weekends, over the past 12 months?

➔ If no, please write “0” in the response section, below.

Please record the usual amount of time you spent sitting during childcare or elder care over the past 12 months.

9. How long did you usually spend
sitting or lying down while caring ___hr ___min ___hr ___min
for your child per day? (weekday) (weekend)
(examples: nursing baby, helping child with homework)
10. How long did you usually spend
sitting down while caring for an ___hr ___min ___hr ___min
elderly family member per day? (weekday) (weekend)
(examples: reading aloud, assistance with eating meals)

SECTION 6 – LIGHT LEISURE AND RELAXING

This section refers to things done for enjoyment, during your own time.

Please record the usual amount of time you spent sitting or lying down in these pursuits over the past 12 months.

SCREEN TIME

- | | |
|--|--|
| 11. How long did you usually spend watching TV (dvds/videos) or playing video games <u>per day</u> ? | ___hr ___min ___hr ___min
<i>(weekday)</i> <i>(weekend)</i> |
| 12. How long did you use a computer for leisure or for additional work on your own time <u>per day</u> ? | ___hr ___min ___hr ___min
<i>(weekday)</i> <i>(weekend)</i> |

Think about the total time you spent watching TV or using a computer during your leisure-time. We are interested in how often you stood up and moved around to “break up” the time you spent sitting or lying down. For example, you might have got up to get a cup of coffee during a commercial break.

13. How often did you “break up” the time you spent watching TV or using a computer during your leisure-time?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>(less than hourly)</i>	<i>(hourly)</i>	<i>(half hourly)</i>	<i>(every 10 mins)</i>	<i>(every 5 mins)</i>

14. How often did you eat snack-foods (e.g. chips, sweets) while watching TV during your leisure-time?

☐
(always)

☐
(usually)

☐
(sometimes)

☐
(rarely)

☐
(never)

OTHER LEISURE PURSUITS

15. How long did you usually spend reading while sitting or lying down per day?

__hr __min __hr __min
(weekday) (weekend)

16. How long did you usually spend in other leisure pursuits while sitting down per day?

__hr __min __hr __min
(weekday) (weekend)

Some examples:

listening to music

talking to friends

sewing/knitting

doing crosswords/puzzles

doing crafts

attending a sporting event

woodworking

playing cards

praying/meditating

writing letter

sitting outdoors

watching a movie at the cinema

SECTION 7 – FINAL QUESTIONS

Were you involved in other daily pursuits done sitting or lying down that were not covered in this questionnaire, on either weekdays or weekends, over the past 12 months?

➔ If no, please continue to question 17.

Please record the usual amount of time you spent sitting or lying down in other pursuits not covered in this questionnaire.

Other pursuits

..... __hr__min__hr__min
 (weekday) (weekend)

..... __hr __min__hr __min
 (weekday) (weekend)

[illegible]

17. Please estimate the amount of time it took to complete the SIT-Q _____hr _____min

[illegible]

Thank you for your help with this questionnaire.

CURRICULUM VITAE

1. PERSONAL INFORMATION:

Name: Marc Moulin

2. EDUCATION:

2014-2016

Western University, London, Ontario, Canada
MS.c Student, Health and Rehabilitation Sciences
Thesis Title: An Assessment of Sedentary Time Among
Undergraduate Students at an Urban Canadian University

2010-2014

Western University, London, Ontario, Canada
Honours B.H.Sc.

3. HONOURS AND AWARDS

2014-2016

Recipient of the Western Graduate Research Scholarship

4. EMPLOYMENT HISTORY

2010-2016

Environmental Service Worker
London Health Sciences Center
London, Ontario, Canada

5. TEACHING EXPERIENCE

Fall 2014

Teaching Assistant
Department of Health Sciences, Western
University, London, Ontario, Canada
Health Sciences 3010F: Introduction to Rural
Communities

Winter 2015-Summer 2015

Teaching Assistant
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Physical Therapy 9630Y

Fall 2015- Summer 2016

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